

Microscopy and Microprobe Studies of Individual Atmospheric Particles Collected During MILAGRO 2006

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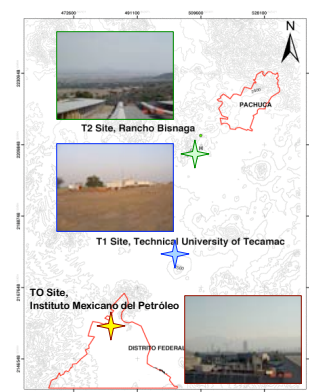
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ABSTRACT

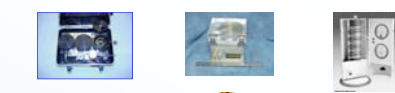
Complementary capabilities of several analytical microscopy and microprobe techniques are being utilized to provide comprehensive chemical and morphological analysis of aerosol samples collected during the 2006 MILAGRO study. The analysis is currently focused to target the following areas: (a) internal structure and mixing characteristics of soot and sulfur containing particles, (b) the phenomenon of emissions of heavy metals and soot from overnight industrial activities at T0, (c) identification of major particulate emissions sources at three sites through composition and morphological analysis, (d) evidence of aerosol processing (chemical reaction or physical mixing) from T0 to T1 to T2, (e) hygroscopic properties of mixed urban aerosol and susceptibility to wet-removal by washout/rainout.

Sample Collection Sites



• Particles were collected from three sites to investigate the spatial and temporal variability of chemical and physical properties. Samples were collected at “T0” (Instituto Mexicano de Petróleo, IMP) in an industrial area within the city, as well as “T1” (Universidad Autónoma de Tecamac) and “T2” (Rancho la Bisanaga) located ~25 km and ~50 km northeast of T0, respectively. These sites were chosen to study generation of pollution inside the city and subsequent transport towards the city boundaries.

Field Sampling Devices

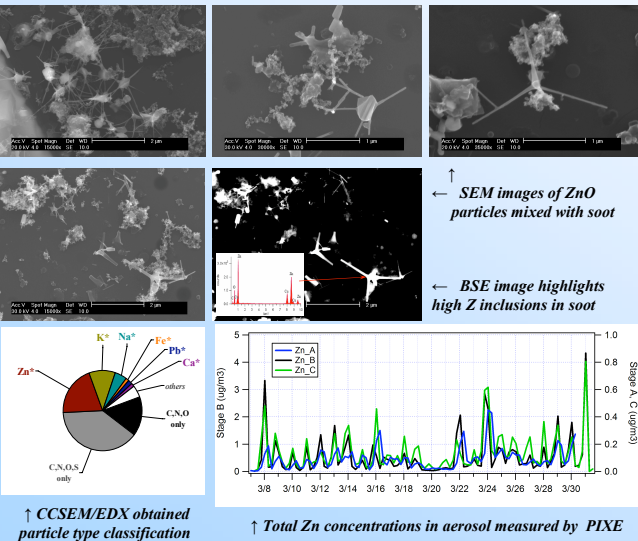


Laboratory Analysis



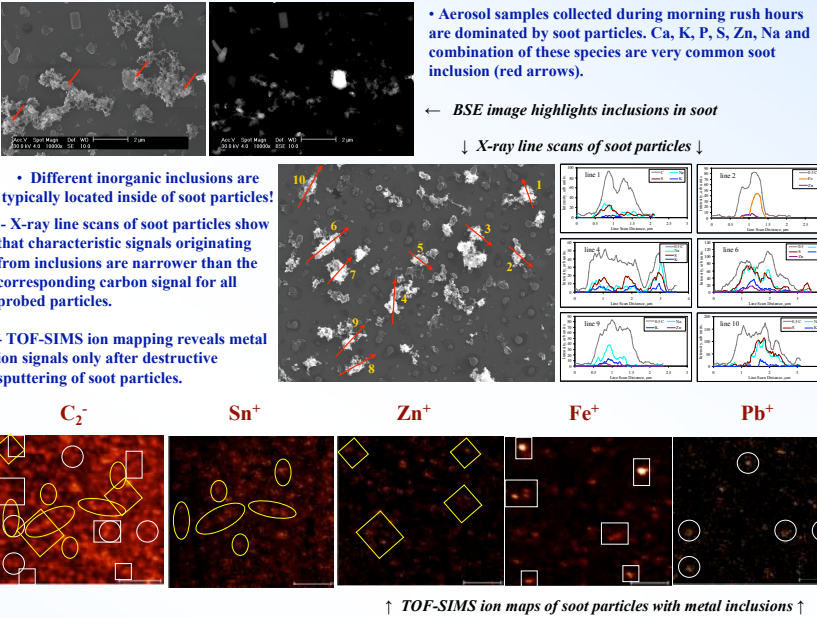
PARTICULATES FROM OVERNIGHT INDUSTRIAL ACTIVITIES AT T0

• Overnight industrial emissions are important sources of metals originating from northern sections of the city. Several early morning (~1am) samples were studied, which corresponded with peak values in various metals including Zn and Pb measured by PIXE. SEM images show fine needle-like Zn particles mixed with soot. Occasional small Pb containing particles were also distinguishable using BSE mode imaging and X-ray analysis. • CCSEM/EDX analysis indicate a profound presence of mixed soot/metal containing particles • PIXE data indicates their night time origin and provides an estimate of the levels of their emissions.



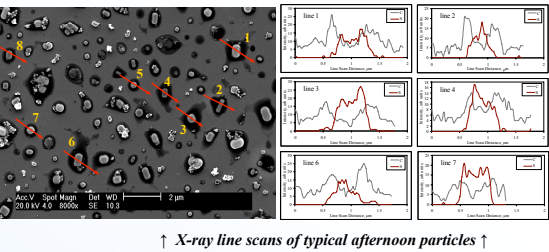
INTERNAL STRUCTURES AND MIXING CHARACTERISTICS OF SOOT AND SULFUR CONTAINING PARTICLES COLLECTED AT T0 SITE

Morning Rush Hour Emissions

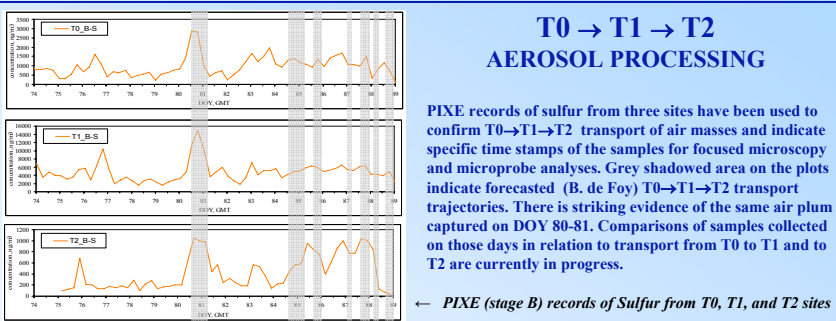
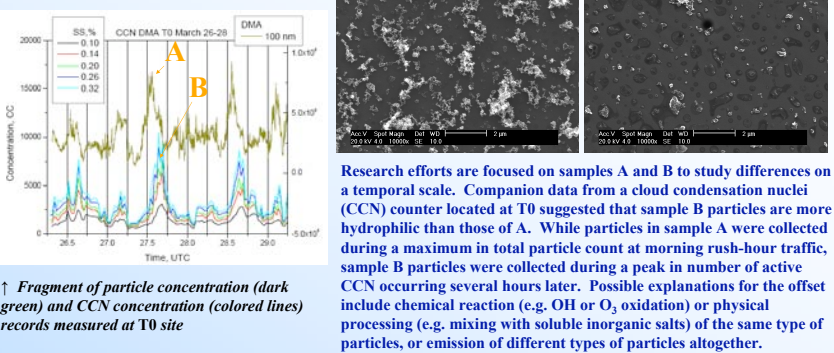


Typical Afternoon Samples

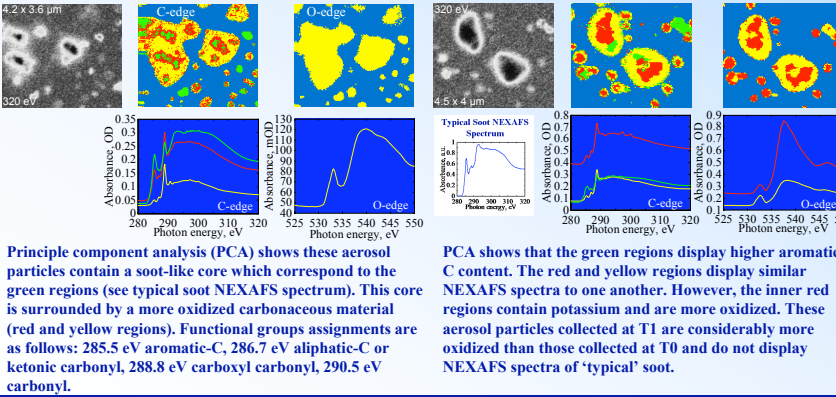
• Aerosol samples collected in the afternoon are dominated by S-containing particles (bright core particles in the SEM image) which are evidently coated by organic compounds (dark hallow). X-ray line scans indicate their carbon content versus S-containing material of bright cores.



CHEMICAL CHARACTERIZATION OF CCN ACTIVE PARTICLES (data from T0 site)

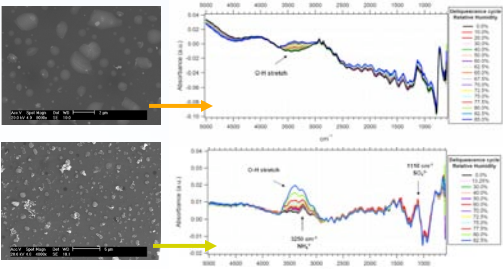


Evolution of Carbonaceous Particles from T0 to T1 – Mixing Characteristics



PROBING HYGROSCOPIC PROPERTIES OF FIELD COLLECTED PARTICLES (data from T0 site)

Current efforts are exploring the method of micro FTIR spectroscopy to study hydration properties of field collected particles. In these experiments, substrates with particles of interest are placed in a cell and then FTIR spectra are recorded as a function of relative humidity. From the FTIR spectra we determine the phase (solid or liquid) and estimate the amount of water associated with the particles. Typically, an ensemble of hundreds of sub-micron particles are monitored in a given experiment. Results from two such experiments are illustrated here.



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